# CZ2003: Tutorial 2

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# Problem 1

Give a definition of mathematical function.

**Solution**
In mathematics, a function is a relation from a set of inputs to a set of possible outputs. A function maps a single input value (or argument) within the input domain to a single output value falling within the function range.

# Problem 2

What ways of defining mathematical functions do you know?

**Solution**
Three ways:

- Implicit functions - a function that will equate to 0
  e.g.: $f(x, y, z, t) = 0$, where $x, y, z$ are Cartesian coordinates and $t$ is the time
- Explicit functions - a function which output is manipulated by its inputs
  e.g.: $g = f(x, y, z, t)$
- Parametric functions - a set of explicit functions which creates values of co-ordinates from inputs consisting of variables from other domain (i.e., parametric coordinates)
  e.g.: $x = f_x(y, v, w, t); y = f_y(u, v, w, t); z = f_z(u, v, w, t)$

# Problem 3

Given an explicit function $y = sin(x) + cos(x)$, propose how to convert it to the respective parametric functions $x = f_1(t)$ $y = f_2(t)$?

**Solution**
We can define the first parametric function as:
$\mathbf{x = f_1(t) = t}$
The second parametric function can then be obtained as:
$\mathbf{y = f_2(t) = sin(t) + cos(t)}$

# Problem 4

i Given parametric functions $x = sin^2(t)$ and $y = cos(t)$, obtain the respective implicit function $f(x, y) = 0$.

ii Given parametric functions $x = 2 + 3t$ and $y = 3 + t$, obtain the respective implicit function $f(x, y) = 0$.

**Solution**
**Part i**

$$\begin{aligned} y &= cos(t) \\ y^2 &= cos^2(t) \\ \therefore x + y^2 &= sin^2(t) + cos^2(t) \\ &= 1 \\ \mathbf{f(x, y) = x + y^2 - 1} &= \mathbf{0} \end{aligned}$$

**Part ii**

$$\begin{aligned} y &= 3 + t \\ 3y &= 9 + 3t \\ 3t &= 3y - 9 \end{aligned}$$

$$\begin{aligned} x &= 2 + (3y - 9) \\ &= 3y - 7 \\ x - 3y &= -7 \\ \mathbf{f(x, y) = x - 3y + 7} &= \mathbf{0} \end{aligned}$$